CLAIMS

1. A method of imaging using magnetic resonance, the method comprising:

administering hyperpolarized noble gas to a subject in a region to be imaged;

applying a magnetic field of a magnitude between about 0.0001 Tesla and about 0.1 Tesla to the subject at least in the region of the subject to be imaged;

detecting a spatial distribution of magnetic resonance signals of the hyperpolarized noble gas in the subject; and

producing a representation of the spatial distribution.

2. The method of claim 1 wherein the noble gas is ^{3}Helium.

3. The method of claim 1 wherein the noble gas is ^{129}Xenon.

4. The method of claim 1 further comprising applying a gradient to the region to be imaged, the gradient having a smoothly varying waveform of amplitude with respect to time.

5. The method of claim 4 further comprising filtering low frequency components of the gradient before applying the gradient to the region to be imaged.

6. The method of claim 1 wherein the subject is alive.

7. The method of claim 1 wherein the subject is inanimate.

8. The method of claim 1 wherein the region of the subject is disposed within an interior volume of a conductive member.

9. The method of claim 1 wherein the region of the subject comprises a portion of a brain of the subject.

10. The method of claim 1 wherein the subject includes at least one of an electrical device, a magnetic device, and an electrically conductive member.

11. The method of claim 10 wherein the electrical device is a pacemaker.

12. The method of claim 1 wherein the hyperpolarized gas comprises Helium and Xenon and wherein the method further comprises differentially imaging the Helium and Xenon gases.

13. The method of claim 1 wherein the applied magnetic field is less than 0.017 Tesla.

14. The method of claim 13 further comprising:

exciting the hyperpolarized noble gas by applying at least one RF pulse to the subject; and

evaluating a signal produced by the hyperpolarized gas in response to the at least one RF pulse to determine at least one of:

ventilation in the subject, at least one characteristic of lung gas in the subject, and perfusion in the subject.

15. The method of claim 14 wherein the at least one RF pulse comprises at least two RF pulses and the method further comprises evaluating signals produced in response to the RF pulses to determine lung gas flow.

16. The method of claim 15 wherein the lung gas flow is determined in real time.

17. The method of claim 13 further comprising exciting the hyperpolarized noble gas by applying at least one RF pulse to the subject using at least one of a RARE pulse sequence, a gradient echo pulse sequence, and EPI pulse sequence, a DANTE pulse sequence.

18. The method of claim 17 wherein the gradient echo pulse sequence uses centric coding.

19. The method of claim 17 wherein the DANTE pulse sequence comprises a Jump Return pulse sequence.

20. The method of claim 13 further comprising sweeping the magnetic field using a continuous wave.

21. The method of claim 13 further comprising exciting the hyperpolarized noble gas by applying at least one RF pulse to the subject using a spin echo pulse sequence.

22. The method of claim 13 further comprising:

exciting the hyperpolarized noble gas by applying a plurality of RF pulses to the subject; and

evaluating a signal produced in response to the RF pulses to determine blood flow in the subject.

23. The method of claim 22 wherein the signal produced in response to the RF pulse is produced by carrier agents mixed with the hyperpolarized gas.

24. The method of claim 13 wherein the at least one RF pulse has a large flip angle.

25. The method of claim 24 wherein the flip angle is about 90 degrees.

26. The method of claim 25 wherein the exciting selectively excites dissolved phase hyperpolarized ^{129}Xe.

27. An imaging system comprising:

a magnetic field apparatus configured to produce a static magnetic field between about 0.0001 Tesla and about 0.1 Tesla;

a gas delivery apparatus adapted to store and deliver hyperpolarized noble gas to a region of a subject to be imaged;

an RF transmitting arrangement configured to provide RF pulses to at least the region of the subject to be imaged;

a detecting arrangement configured detect signals produced by hyperpolarized gas in response to receiving an RF pulse in a static magnetic field between about 0.0001 Tesla and about 0.1 Tesla; and

a processor adapted to receive indications of the signals from the detecting arrangement and to process the indications into a representation of a spatial distribution of the hyperpolarized noble gas delivered to the subject.

28. The system of claim 27 wherein the RF transmitting arrangement and the detecting arrangement comprise a common coil arrangement.

29. The system of claim 27 wherein the RF transmitting arrangement comprises a first coil arrangement and the detecting arrangement comprises a second coil arrangement disposed substantially perpendicular to the first coil arrangement.

30. The system of claim 27 wherein the noble gas is ^{3}Helium.

31. The system of claim 27 wherein the noble gas is ^{129}Xenon.

32. The system of claim 27 further comprising an electrically conductive shield disposed between the magnetic field apparatus and the subject.

33. The system of claim 27 further comprising a gradient arrangement configured to provide gradients to the subject.

34. The system of claim 33 wherein the gradient arrangement is configured to provide gradients having smoothly varying waveforms of amplitude with respect to time in response to control signals from a controller.

35. The system of claim 34 wherein the gradient arrangement comprises a gradient filter configured to filter low frequency components of the gradients.

36. The system of claim 34 wherein the gradient arrangement further comprises a gradient amplifier coupled to a gradient coil through the gradient filter, and wherein the gradient filter is disposed at a point where a line coupling the gradient amplifier to the gradient coil enters a shielded room.

37. The system of claim 27 wherein the RF transmitting arrangement comprises an RF coil and the system further comprises an electrically conductive RF coil shield configured to contain the RF coil and enclosing a volume approximately equal to, but larger than, a volume partially enclosed by the RF coil.

38. The system of claim 27 wherein the magnetic field apparatus has a substantially open configuration.

39. An imaging system comprising:

means for applying a static magnetic field between about 0.0001 Tesla and about 0.1 Tesla to a subject;

a gas delivery apparatus adapted to store and deliver hyperpolarized noble gas to a region of the subject to be imaged;

an RF transmitting arrangement configured to provide RF pulses to at least the region of the subject to be imaged;

means for detecting signals produced by hyperpolarized gas in response to receiving an RF pulse in a static magnetic field between about 0.0001 Tesla and about 0.1 Tesla; and

a processor adapted to receive indications of the signals from the detecting arrangement and to process the indications into a representation of a spatial distribution of the hyperpolarized noble gas delivered to the subject.

40. A method of imaging using magnetic resonance, the method comprising:

administering hyperpolarized noble gas to a subject in a region to be imaged;

applying a magnetic field of a magnitude below 0.0001 Tesla to the subject at least in the region of the subject to be imaged;

detecting a spatial distribution of magnetic resonance signals of the hyperpolarized noble gas in the subject; and

producing a representation of the spatial distribution.